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# REPORT NO. 95-09

# STEEL AMMUNITION BINS MIL-STD-1660 TESTS



Prepared for:
U.S. Army Armament Research, Development and Engineering Center
ATTN: AMSTA-AR-ESK
Rock Island, IL 61299-7300

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**VALIDATION ENGINEERING DIVISION**
**SAVANNA, ILLINOIS 61074-9639**

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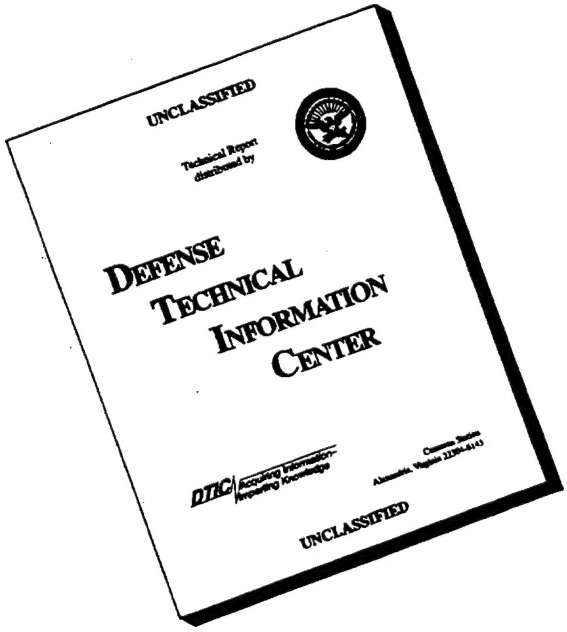


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19. ABSTRACT (*Continue on reverse if necessary and identify by block number*)

The U.S. Army Defense Ammunition Center and School (USADACS), Validation Engineering Division (SIOAC-DEV), was tasked by the U.S. Army Armament Research, Development and Engineering Center (ARDEC) to conduct MIL-STD-1660 tests on steel ammunition bins with newly-designed plywood lids for use in the transportation of hazardous waste. This report contains test results of the steel ammunition bins with plywood lids meeting MIL-STD-1660, Design Criteria for Ammunition Unit Loads, test procedures.

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U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL
VALIDATION ENGINEERING DIVISION
SAVANNA, IL 61074-9639

REPORT NO. 95-09

# STEEL AMMUNITION BINS MIL-STD-1660 TESTS

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PART 1

# INTRODUCTION

A. BACKGROUND. The U.S. Army Defense Ammunition Center and School (USADACS), Validation Engineering Division (SIOAC-DEV), was tasked by the U.S. Army Armament Research, Development and Engineering Center (ARDEC) to conduct MIL-STD-1660 tests on steel ammunition bins with newly-designed plywood lids for use in the transportation of hazardous waste.

B. AUTHORITY. This test was conducted IAW mission responsibilities delegated by the U.S. Army Industrial Operations Command (IOC), Rock Island, IL.

C. OBJECTIVE. The objective of this test was to ascertain that loaded steel ammunition bins with the newly-designed plywood lids are not damaged during transportation.

D. CONCLUSION. The steel ammunition bin and plywood lid, unitized as one box and one lid, completed MIL-STD-1660 tests, with little damage occurring to the box or lid.

E. RECOMMENDATION. It is recommended that silicone caulk be used at the junction of the lid and the container to provide a tighter seal.

PART 2

16 MARCH 1995

ATTENDEES

| | |
|---|---|
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# PART 3

## TEST PROCEDURES

The test procedures outlined in this section were extracted from MIL-STD-1660, Design Criteria for Ammunition Unit Loads, 8 April 1977. This standard identifies nine steps that a unitized load must undergo if it is to be considered acceptable. The four tests that were conducted on the test pallets are summarized below.

A. SUPERIMPOSED LOAD TEST. The unit load was loaded to simulate a stack of identical unit loads stacked 16 feet high for a period of one hour. This stacking load is simulated by subjecting the unit load to a compression weight equal to an equivalent 16-foot stacking height. The compression load is calculated in the following manner. The unit load weight is divided by the unit load height in inches and multiplied by 192. The resulting number is the equivalent compressive force of a 16-foot-high load.

B. REPETITIVE SHOCK TEST. The repetitive shock test was conducted IAW Method 5019, Federal Standard 101. The test procedure is as follows: The test specimen was placed on, but not fastened to, the platform. With the specimen in one position, the platform was vibrated at 1/2-inch amplitude (1-inch double amplitude) starting at a frequency of approximately 3 cycles per second. The frequency was steadily increased until the package left the platform. The resonant frequency is achieved when a 1/16-inch-thick feeler gage may be momentarily slid freely between every point on the specimen in contact with the platform at some instance during the cycle or a platform acceleration achieved 1 +/- 0.1 G. Midway into the testing period, the specimen was rotated 90 degrees and the test continued for the duration. Unless failure occurs, the total time of vibration is two hours when the specimen is tested in one position. When the specimen is tested in more than one position, the total time is three hours.

C. EDGEWISE ROTATIONAL DROP TEST. This test was conducted using the procedures of Method 5008, Federal Standard 101. The procedure for the Edgewise Rotational Drop Test is as follows: The specimen was placed on its skids with one end of the pallet supported on a beam 4-1/2 inches high. The height of the beam was increased, when necessary, to ensure that there was no support for the skids between the ends of the pallet when dropping took place, but was not high enough to cause the pallet to slide on the supports when the dropped end was raised for the drops. The unsupported end of the pallet was then raised and allowed to fall freely to the concrete, pavement, or similar underlying surface from a prescribed height. Unless otherwise specified, the height of drop for level A protection shall conform to the following tabulation:

| GROSS WEIGHT NOT EXCEEDING (Pounds) | DIMENSIONS ON ANY EDGE NOT EXCEEDING (Inches) | HEIGHT OF DROP LEVEL A PROTECTION (Inches) |
|---|---|---|
| 600 | 72 | 36 |
| 3,000 | no limit | 24 |
| no limit | no limit | 12 |

D. INCLINE-IMPACT TEST. This test was conducted by using the procedure of Method 5023, Incline-Impact Test of Federal Standard 101. The procedure for the Incline-Impact Test is as follows: The specimen was placed on the carriage with the surface or edge to be impacted projecting at least 2 inches beyond the front end of the carriage. The carriage was brought to a predetermined position on the incline and released. If it is desired to concentrate the impact on any particular position on the container, a 4- by 4-inch timber may be attached to the bumper in the desired position before the test. No part of the timber was struck by the carriage. The position of the container on the carriage and the sequence in which surfaces

and edges were subjected to impacts was at the option of the testing activity and depended upon the objective of the tests. When the test is to determine satisfactory requirements for a container or pack, and, unless otherwise specified, the specimen was subjected to one impact on each surface that has each dimension less than 9.5 feet. Unless otherwise specified, the velocity at time of impact was 7 feet-per-second.

PART 4

## TEST EQUIPMENT

A. 2 Steel Ammunition Bins with Plywood Lids Strapped Together (test sample).

| | |
|---|---|
| 1. Container No. (top). | H789 |
| 2. Container No. (bottom). | H751 |
| 3. Width. | 50-3/8 inches |
| 4. Length. | 26 inches |
| 5. Weight Empty. | 224 pounds |
| 6. Weight Loaded. | 2,460 pounds |
| 7. Height. | 31 inches |

B. Steel Ammunition Bin with Plywood Lid (test sample).

| | |
|---|---|
| 1. Container No. | H789 |
| 2. Width. | 50-3/8 inches |
| 3. Length. | 26 inches |
| 4. Depth. | 11 inches |
| 5. Weight Empty. | 112 pounds |
| 6. Weight Loaded. | 1,230 pounds |
| 7. Height Loaded. | 16 inches |

C. Compression Tester.

| | |
|---|---|
| 1. Manufacturer. | Ormond Manufacturing |
| 2. Platform. | 60 inches by 60 inches |
| 3. Compression Limit. | 50,000 pounds |
| 4. Tension Limit. | 50,000 pounds |

D. Transportation Simulator.

| | |
|---|---|
| 1. Manufacturer. | Gaynes Laboratory |
| 2. Capacity. | 6,000-pound pallet |
| 3. Displacement. | 1/2-inch amplitude |
| 4. Speed. | 50 rpm to 400 rpm |
| 5. Platform. | 5- by 8-foot |

E. Inclined Plane.

| | |
|---|---|
| 1. Manufacturer. | Conbur Incline |
| 2. Type. | Impact Tester |
| 3. Grade. | 10 percent incline |
| 4. Length. | 12 feet |

PART 5

## TEST RESULTS

TEST OBSERVATION. Two iterations were required before the container passed. The first iteration consisted of a container strapped on the lid of a second container. Damage occurred to the lid and the skids of the bottom container. The second iteration consisted of a single container and a lid designed to support the outside skids of the container stacked above it. The center of the stacked container was suspended in order to prevent the lid from sagging in the center. This was accomplished by placing a 2- by 4-inch piece of lumber on top of the plywood lid flush with the end of the lid (see part 7).

FIRST ITERATION:

A. SUPERIMPOSED LOAD TEST. The test specimen was initially loaded to 15,236 pounds compression for a period of 60 minutes. The stacking lugs on the top container embedded into the lid of the top container. Additionally, the weight of the top container transmitted through the center skid of the top container onto the lid of the bottom container, causing the lid to sag in the center.

B. REPETITIVE SHOCK TEST. The duration of the test was 90 minutes for each orientation of the pallet. In order to achieve clearance between the container and the transport simulator bed, the equipment was operated at 222 rpm for the longitudinal orientation and 235 rpm for the lateral orientation. During each vibration orientation, the skids on the top container continued to damage the lid on the bottom container.

C. EDGEWISE ROTATIONAL DROP TEST. One side of the container was placed on a beam displacing it 4-1/2-inches above the floor. The opposite end of the container was raised to

a height of 18 inches, then dropped. A height of 18 inches was used instead of the prescribed 24 inches due to the dimensions of the container. For each of the lateral impacts, the outside skid bent inward. Following the impact, one outside skid came off the ground approximately 1/2-inch, causing the container to no longer be stackable.

D. INCLINE-IMPACT TEST. The inclined plane was set to allow the pallets to travel 8 feet prior to impacting a stationary wall. The pallet was rotated clockwise after each impact, until all four sides had been tested. No damage was noted.

SECOND ITERATION:

A. SUPERIMPOSED LOAD TEST. The test container was initially loaded to 16,320 pounds compression. The compression was released after 1 hour. No damage was noted.

B. REPETITIVE SHOCK TEST. The duration of the test was 90 minutes for each orientation of the pallet. The transportation simulator was set at 237 rpm for the longitudinal orientation and 242 rpm for the lateral orientation of the container. Throughout the duration of the test, a very small amount of steel shot escaped between the container lip and the lid. Installation of silicone caulk at the junction of the lid and the container is recommended to prevent any contents from escaping from the container.

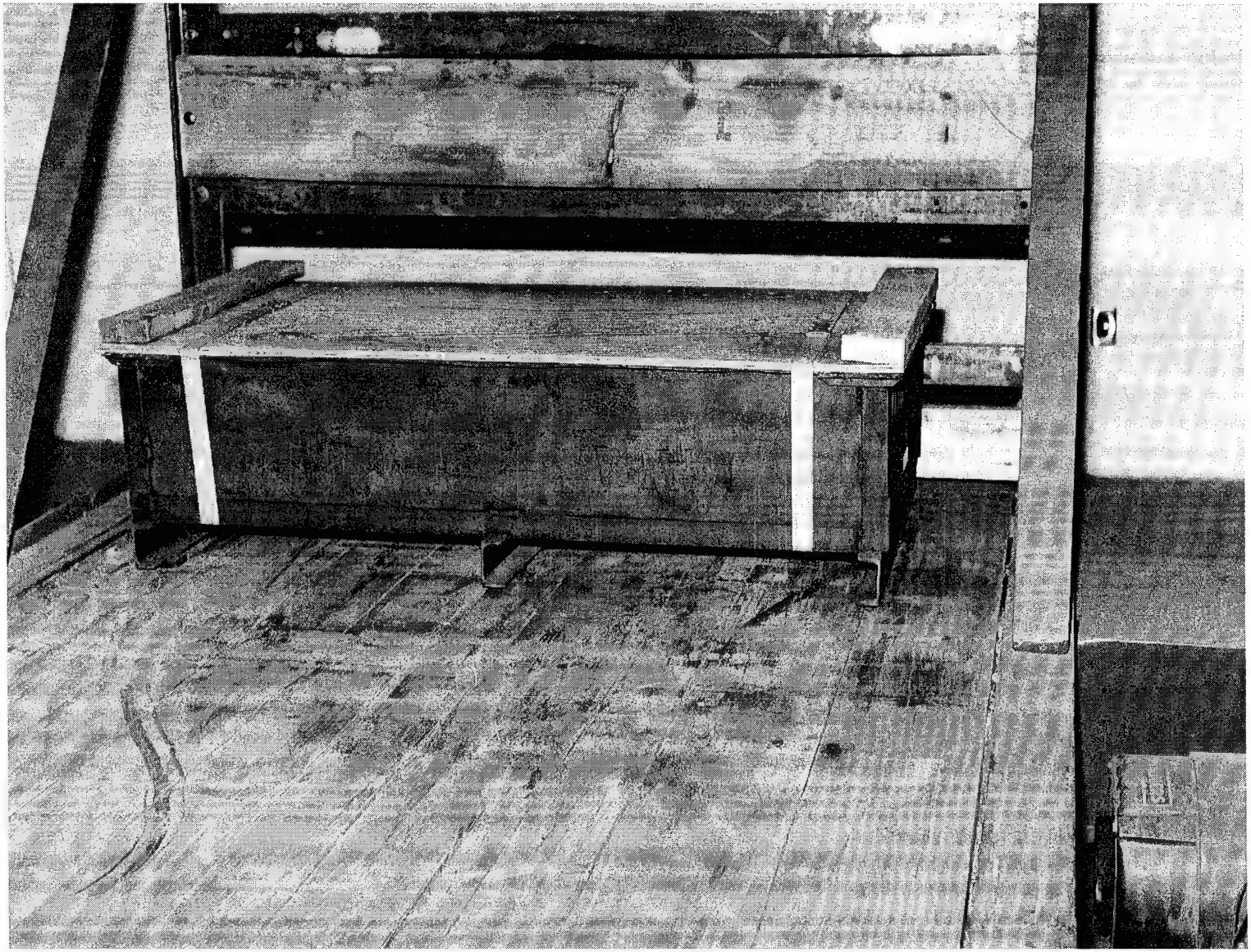
C. EDGEWISE ROTATIONAL DROP TEST. One side of the container was placed on a beam displacing it 4-1/2-inches above the floor. The opposite end of the container was raised to a height of 18 inches, then dropped. A height of 18 inches was used instead of the prescribed 24-inches due to the dimensions of the container. No damage was noted.

D. INCLINE-IMPACT TEST. The inclined plane was set to allow the pallets to travel 8 feet prior to impacting a stationary wall. The pallet was rotated clockwise after each impact, until all four sides had been tested. No damage was noted.

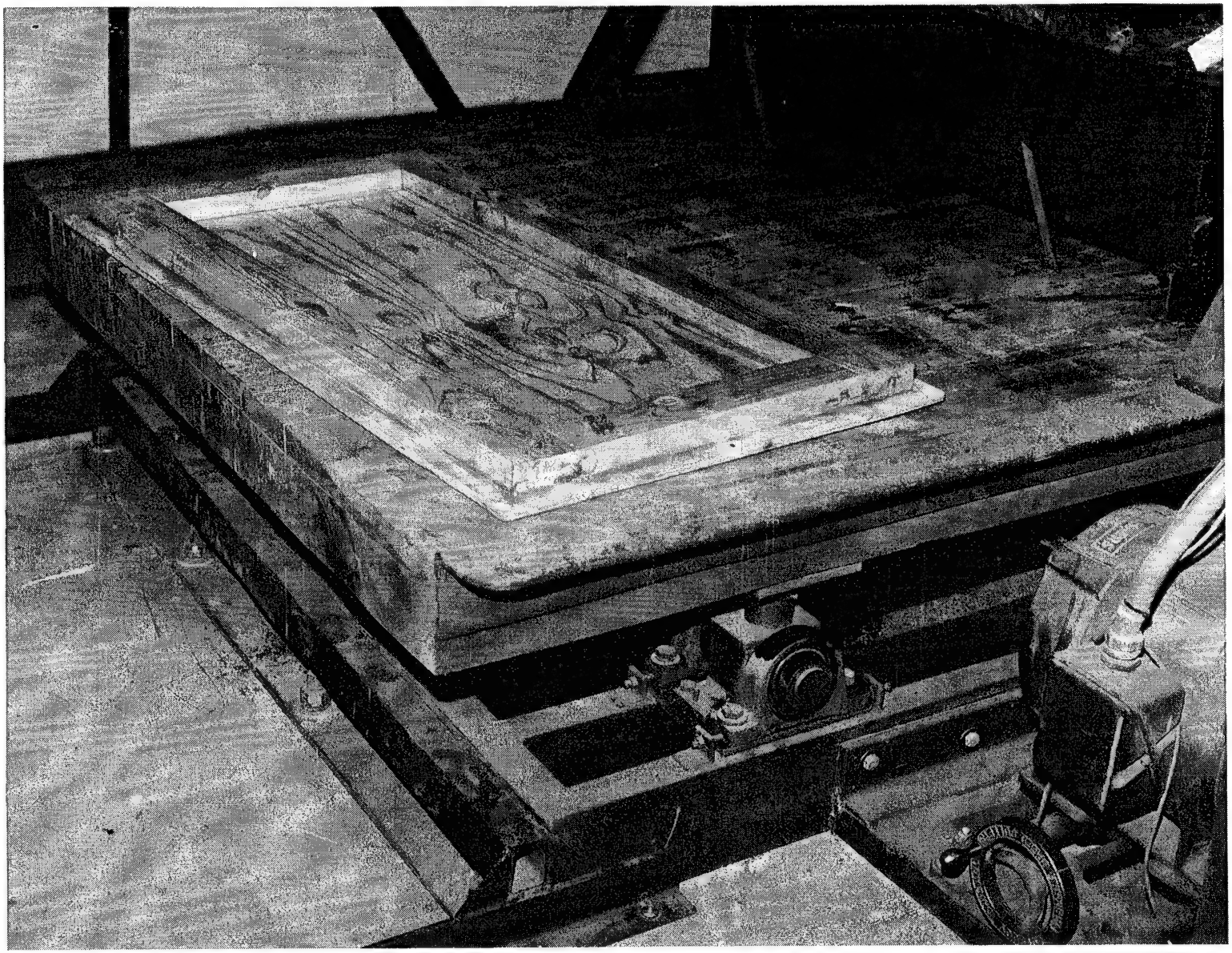
E. END OF TEST INSPECTION. A small amount of pealing along the edge of the plywood lid existed. This damage was caused by the sling used to rotate the container. While lifting the container with the sling, the edge of the plywood was rubbed causing the plywood to fray; however, the lid continued to effectively enclose the steel ammunition bin. No other damage was noted.

PART 6

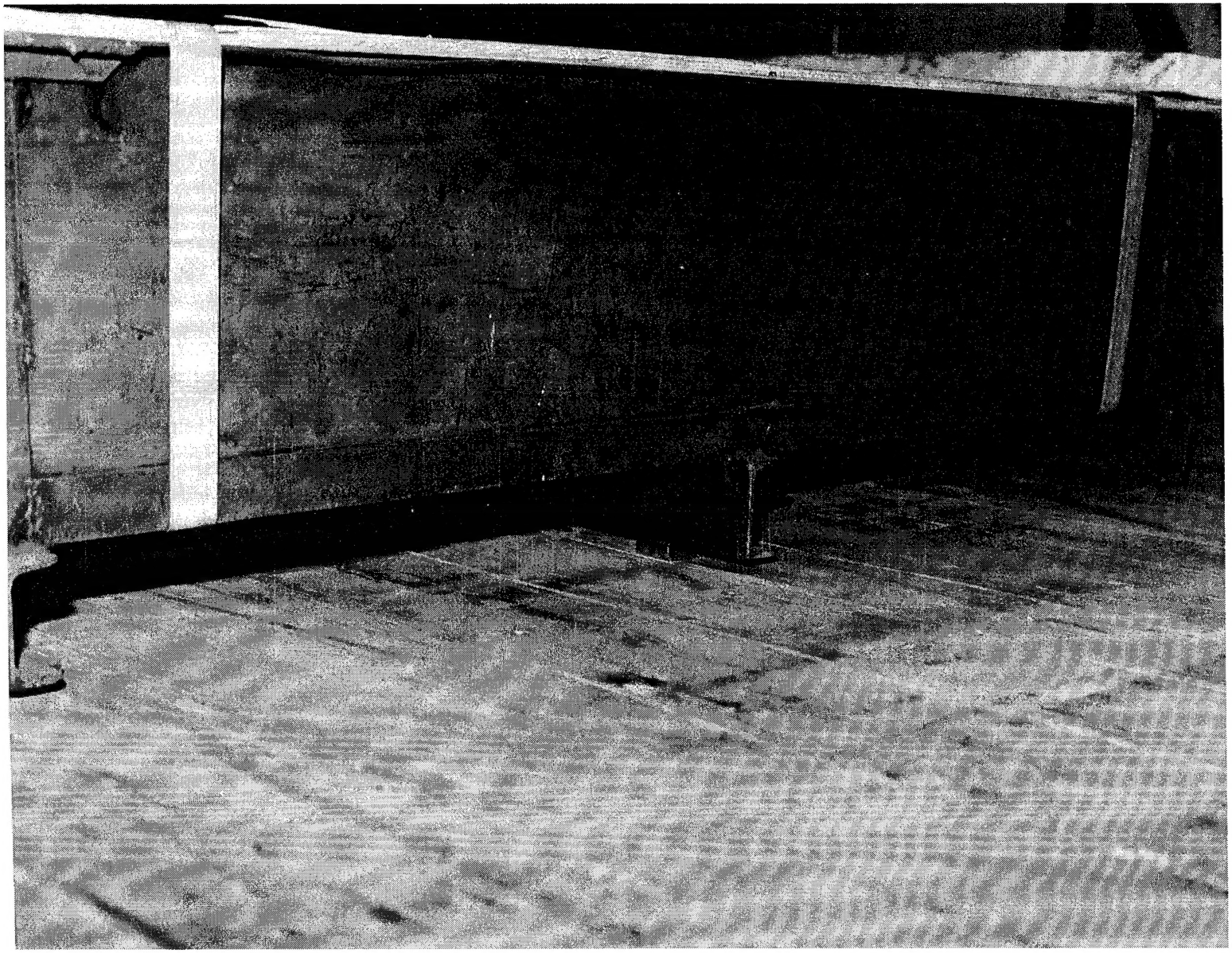
PHOTOGRAPHS



| | U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL | |
|---|---|---|
| AO317-SCN95-123-1303. This photo shows the overall view of the steel ammunition bin with lid. Note the indentations in the 2- by 4-inch lumber from self-nesting stacking lugs. Note also that two 1-1/4-inch bands were used. | | |



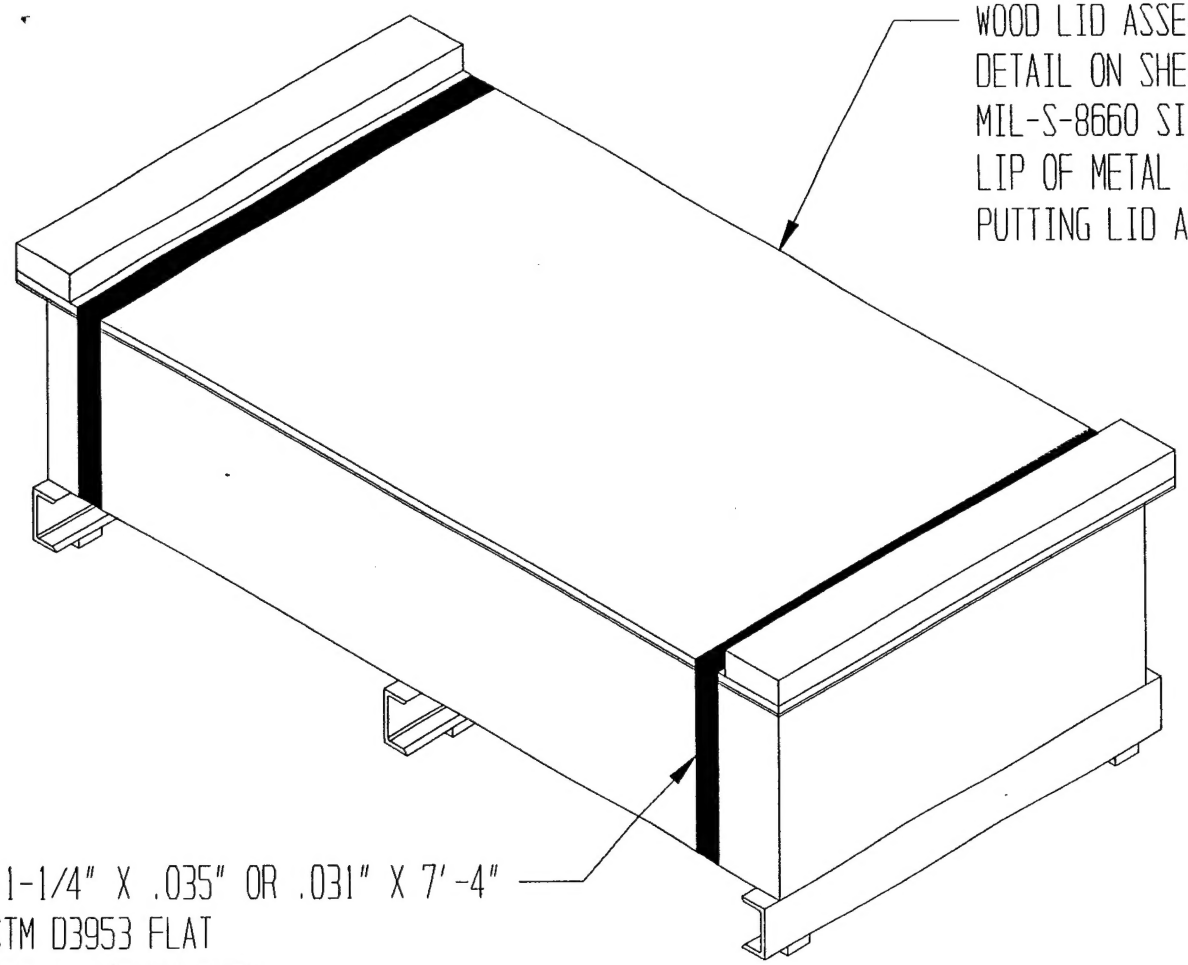
| | U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL | |
|---|---|---|
| AO317-SCN95-123-1301. This photo shows the view of the bottom of the lid. Recommend silicone caulk be placed on the plywood along the outside of the 2- by 4-inch lumber frame. | | |



| | U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL | |
|---|---|---|
| .AO317-SCN95-123-1304. This photo shows the view of the steel ammunition bin. Note the stacking lugs at the bottom of the skids. | | |

# PART 7

## DRAWING



WOOD LID ASSEMBLY, 1 REQD; SEE DETAIL ON SHEET 2. APPLY MIL-S-8660 SILICON SEALANT TO LIP OF METAL CONTAINER BEFORE PUTTING LID ASSEMBLY ON CONTAINER.

STEEL STRAP, 1-1/4" X .035" OR .031" X 7'-4" (2 REQD). ASTM D3953 FLAT STRAPPING, TYPE 1, HEAVY DUTY, FINISH B, GRADE 1,2 OR 3.

METAL HAZARDOUS WASTE CONTAINER
FOR TRANSPORT OF WASTE FROM LAKE CITY MINNESOTA, TWIN CITIES AMMUNITION PLANT, TO ILLINOIS.
MAXIMUM WEIGHT OF CONTENTS WITH CONTAINER AND LID IS 1,100 LBS.
WOODEN LID ASSEMBLY DESIGNED AND TESTED BY USADACS, SMCAC-DEV
WILLIAM MEYER AND BRAD HAAS
APRIL 1995.

NOTES:

1. FOR ANY STORAGE MORE THAN 30 DAYS THE PLYWOOD WILL BE IAW COMMERCIAL ITEM DESCRIPTION A-A-55057, TYPE A, CONSTRUCTION AND INDUSTRIAL PLYWOOD, INTERIOR WITH EXTERIOR GLUE, GRADE C-D. IF SPECIFIED GRADE IS NOT AVAILABLE, A BETTER INTERIOR OR AN EXTERIOR GRADE MAY BE SUBSTITUTED.
2. DUNNAGE LUMBER WILL BE IAW TM 743-200-1 AND FED SPEC MM-L-751. ALL LUMBER USED FOR ANY STORAGE MORE THAN 90 DAYS WILL BE PRESERVATIVE TREATED IAW THE PROCEDURES SPECIFIED IN MIL-B-2427 FOR CLEATED WOODEN BOXES. THE LETTERS PA DENOTING PO56 (COPPER QUINOLINOLATE), PB DENOTING M-GARD W550 (ZINC NAPHTHENATE EMULSIFIABLE) OR PC DENOTING M-GARD W510 OR CUNAPSOL (COPPER NAPHTHENATE) MUST BE APPLIED TO THE OUTSIDE OF THE WOODEN LID IN LETTERS AT LEAST ONE INCH HIGH.
3. THE METAL TUBS AND WOODEN LIDS MAY BE REUSED IF THERE ARE NO HOLES, CRACKS OR OTHER DAMAGE WHICH WOULD ALLOW WASTE TO LEAVE THE INTERIOR OF THE CONTAINER.
4. ALL DIMENSIONS OF THE WOODEN LID MUST BE FIELD CHECKED PRIOR TO CONSTRUCTION TO ASSURE PROPER FIT. THE WOODEN LIDS SHOULD FIT SNUGLY INSIDE THE OPENING OF THE METAL TUB AND REST ON THE LIP OF THE TUB TO ASSURE A TIGHT, SECURE FIT.